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Star.	Pos.	No. Obs.	Dist.	No. Obs.	Epoch.	
	°		″			
α Centauri	23·0	7	9·8	10	1871·215	
	22·7	8	9·83	10	1871·22	
	23·2	5	10·0	6	1871·307	
	24·3	5	9·8	10	1871·32	
	23·8	7	9·9	20	1871·326	Some E., others W.
	24·2	8	9·66	10	1871·389	
	24·9	5	9·9	20	1871·391	
Mean	23·7	45	9·8	86	1871·31	
γ Coronæ Aust.	318·5	6			1863·775	
	317·6	12			1863·849	
	318·8	7			1863·857	
	318·4	5			1863·865	
Mean	318·1	30			1863·836	
	285·5	5			1870·187	Taken with a lower power than usual, and therefore perhaps subject to extra error.
	287·6	7			1870·193	
Mean	286·9	12			1870·19	
	281·9	12			1871·22	

On Humidity as a Cause of Variation of Rate in Chronometers.

By Major-General J. F. Tennant, R.E., F.R.S.

About the end of March, 1882, I borrowed from the Government stores a chronometer by Thomas Fletcher of London, No. 2684; it had been some time in India, but had not been cleaned since its arrival, and was said to have a good rate. When it came to me the rate was about $-6^{\mathrm{s}}{\cdot}5$ (gaining), and this it seemed to keep fairly till the end of May (149$^{\mathrm{d}}$). (I shall use the days of the year frequently, as I can readily take them from my graphic projection of data.) Then the rate suddenly fell to $-2^{\mathrm{s}}{\cdot}0$ between 150$^{\mathrm{d}}$ and 170$^{\mathrm{d}}$, rose nearly a second for a week, and then with small variations continued to fall till about 270$^{\mathrm{d}}$, when it became insensible. At 290$^{\mathrm{d}}$ it rose a little, but shortly after I left Calcutta for a short holiday, and missed a period

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which would have been interesting. Of course, the watch ran down, and when I returned and started it again, after some unsteadiness, the rate was $-2\frac{1}{4}^{s}$ from 310^{d} to 316^{d}, and it rose to $-8^{s}{\cdot}0$ about 330^{d} to 350^{d} on the average. It again accidentally ran down, but was started towards the end of the year, and in the beginning of 1883 the rate was $-7^{s}{\cdot}8$, and it gradually rose numerically till in the period 59^{d}–65^{d} it was $-9^{s}{\cdot}2$. From 65^{d}–74^{d} the rate fell to $-6^{s}{\cdot}8$, and, after a slight rise, it gradually fell from 85^{d} till about 180^{d} it became $+0^{s}{\cdot}2$, and the change went on till, about the beginning of the present month (245^{d}), it was $-2^{s}{\cdot}6$.

I have compared these rates with a plot of the published daily mean temperatures at the Meteorological Observatory. Of course that is not quite satisfactory; but though at first sight it would seem that the rate depends on temperature, farther examination shows that it can only do so to a small extent, and confirms the belief I had from general impressions, and that which was formed by others who used it, that the rate does not depend on temperature. Except occasionally, when carefully carried by myself to a place where I could observe the Port Time Ball, which has been used for determining errors, the chronometer has stood in a room sheltered from sun, but always open to the air more or less. It is, however, certainly cooler in the hot season, and probably warmer in the cold season, than the outer air, and with a far more equable temperature. It has stood, too, in its outer case.

There was a cold period in 1882, about 130^{d}, when the mean of some days of temperature was about 77° F., and the rate was $-6^{s}{\cdot}7$. It was the same at 120^{d}, when the average was about 85° F., and about 140^{d}, when it was $-6^{s}{\cdot}0$. On the other hand, about 270^{d}, when the rate was $0^{s}{\cdot}0$, the temperature was about $83^{\circ}{\cdot}5$ F. About 1883, 30^{d}, the temperature averaged barely 60°, while the rate was about $-8^{s}{\cdot}0$ on the average. When the rate was $-9^{s}{\cdot}2$ the temperature was about 78° F., whereas recently, when the rate has been losing rather than gaining, the temperature is about 82° F.

But there is no doubt that there is, however, a periodic change of rate, and I believe the cause to be *humidity*. My first suspicion was raised by the sudden fall of rate this year being coincident with the first heavy rains producing great damp, and the fact that it was so last year, and that the whole period of low gaining-rate was that of the rains, while the lowest was the warm time at the end of the rains, when the soil is loaded generally with moisture. The same phenomenon has recurred. It is, however, much more difficult to compare the supposed cause and effect without special arrangements. In my room the damp rises largely from the ground, and after very heavy rain the floor is discoloured, or even glistening with moisture in the early morning. The humidity of the air taken at the Observatory is thus no real measure of that of the room, but in any case

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it is doubtful whether air-humidity could be more than a rough guide.

If, as I suspect in this case, the oil on the arbours of the balance be hygroscopic, it is easy to see that it may become more fluid in damp weather, the arc of oscillation will increase, the balance vibration take longer, and the watch lose; but the momentary humidity of the air will not correspond to the rate as the temperature does more or less. Such a general accordance as I have shown seems the only possible result of comparison. But there seems in this case to me an undoubted connection, and it may be worth making special experiments in the following directions:

1st. Are chronometer oils, or any of them, hygroscopic?

2nd. Can they become so by exposure to a tropical climate? And in this last case I conceive that the climatic influence cannot be imitated in Europe. The effect of the heat, and probably the light, are very destructive of some materials. For instance, vulcanised indiarubber will not bear exposure in India, though it seems to answer in Europe even in heat and damp.

Lastly, in estimating the effect of humidity on a given chronometer, it will probably be best to use one of the old hair or grass hygroscopes for the humidity, placing it in the case enclosed with the watch.

P.S. As I shall be leaving India soon I shall not be in a position to investigate any farther with this watch.

H. M.'s Mint, Calcutta:
1883, *September* 14.

Showers of Large Meteors. The Muscids (*Oct.* 17–22) *and Herculids* (*Oct.* 17–26). By W. F. Denning.

A large meteor seen here on October 17, 1883, at $9^h 33^m$, as it traversed a nearly vertical path of 28° amongst the stars of *Hercules*, evidently belonged to a radiant point between *Aries* and *Taurus*, forming an early member of the prominent shower of Muscids (Oct. 25–Nov. 6), to which I called special attention in the *Monthly Notices*, vol. xlii. pp. 34–7. I had no idea, however, that this shower occurred with considerable brightness simultaneously with the Orionids, but on projecting the catalogued paths of a great many fireballs observed during the October meteoric epoch (Oct. 17–22) I found that the principal radiant lies at a very definite point S. of *Musca*, in the E. region of *Aries*, and close to the diverging focus of the later shower above referred to. In fact, this particular stream apparently gives many meteors of the finest class from about the middle of October